20. Climate change

20.1 Existing environment and background

20.1.1 Overview

This chapter draws on information from Appendix Q (Climate change adaptation plan).

20.1.2 Policy and planning setting

The assessment considered the following relevant policies and guidelines:

- Carbon Estimate and Reporting Tool (Transport for NSW, 2017a)
- AS 5334:2013 – Climate change adaptation for settlements and infrastructure – a risk-based approach (Standards Australia, 2018a)
- AS ISO 31000-2018 Risk Management – Guidelines (Standards Australia, 2018b)
- Section J Energy Efficiency of the National Construction Code (Australian Building Codes Board, 2019)
- Green Star Buildings Version 1.0 (Green Building Council of Australia, 2020)
- Climate Risk Assessment Guidelines version 4.0 (Transport for NSW, 2021c)
- Central Precinct Renewal Program – Environmental Sustainability, Climate Change, and Waste Management (Transport for NSW, 2022h)
- Central Precinct Renewal program – Green Infrastructure Strategy (Transport for NSW, 2022k)
- Sydney Terminal Building Revitalisation Project – Scoping Report (Transport for NSW & Arup, 2022).

A comparative assessment of Australian and global rating tools has been carried out to assess the most applicable rating tool for the project. While the Infrastructure Sustainability Rating from Infrastructure Sustainability Council of Australia is typically used on transport infrastructure projects, its lack of focus on amenity, health and wellbeing misses a range of outcomes that are critical to successful property and public realm development (Transport for NSW, 2022h). As such, Green Star was selected as it provides an optimal balance of scope coverage allows consistent carriage of responsibility between different stages of the project life cycle, and at both the project-wide scale and for the individual buildings.

20.1.3 Current climate characteristics

The Sydney Terminal Building is in a warm temperate climate (Australian Building Codes Board, 2022), which experiences a low daily temperature range and four distinct seasons. Climate data for Sydney is shown in Table 20-1.

Table 20-1: Current climate data for Sydney

Climate variable	Current climate
Temperature	
Mean maximum temperature	22.8^{0}C
Mean minimum temperature	14.7^{0}C
Number of hot days (>30^{0}C)	19 hot days
Number of cold nights (<2^{0}C)	0 cold nights
Rainfall	
Mean rainfall	1150mm annually
Mean number of days with rainfall	134 rainy days
Mean number of days with extreme rainfall (>25mm)	12 extreme rainy days
Other variables	
Solar radiation	16.4 MJ/m^2/day
Relative daytime humidity	56–70% relative humidity

Source: Bureau of Meteorology (2020)

20.1.4 Climate projections

Projection timeframes were selected with reference to the Transport Climate Risk Assessment Guidelines v4.0 (Transport for NSW, 2021c), which are based on the wider NSW and Australian Regional Climate Modelling (NARCliM) v1.0 projections (NSW Government, 2014). Therefore, to evaluate the climate risks in both the short and long term, the years 2050 and 2090 were selected to align with the expected design life of the building.

A summary of the climate projections for the NSW region are shown (as a change from the 2020 data) in Table 20-2.

Table 20-2: Climate change risks for NSW

Variable	Projection
Increase in average temperature	2050: +1^{0}C 2090: +3.7^{0}C
Extreme temperatures (above 35^{0}C)	2050: >11 days more 2090: >20 days more
Extreme temperatures (below 2^{0}C)	2050: 0 days 2090: 0 days
Precipitation and drought	Time spent in drought is projected, with medium confidence, to increase over the course of the century.
Increase/decrease in annual rainfall	2050: –4.3% change in rainfall 2090: –12.7% change in rainfall
Bushfire *Source: NSW Government, 2014*	In 2030, high fire danger days is expected to decrease by 0.5 days while the regional areas are to increase by 0.5 days. Meanwhile, in 2070 the high fire danger days is projected to increase to a day and the regional areas around to 1.5 days which is critical due to the smoke that can still impact the site.

Source: Climate Change in Australia (NSW Government, 2019a)

Note, the bushfire climate projections use the 2030 and 2070 time periods as 2050 and 2090 projections were not available. Climate Change in Australia projections state that "a harsher fire-weather climate in the future" is projected with high confidence. Therefore, while this presents a data gap, it can be expected that the high fire danger would continue to increase beyond 2070 to 2090, in line with the above projections.

20.2 Climate change risk assessment

A climate change risk assessment was carried out in accordance with AS 5334:2013 (Standards Australia, 2018a) and the Climate Risk Assessment Guidelines v4.0 (Transport for NSW, 2021c), and in line with the requirements outlined in Green Star Buildings v1.0 (Green Building Council of Australia, 2020). Risks were characterised as low, medium, high or extreme. These are described in Table 20-3 below.

Table 20-3: Risk tolerance and response

Risk rating	Response
Extreme	Extreme risks are generally intolerable and should be avoided except in extraordinary circumstances. An alternative solution must be found, and all necessary steps must be taken to reduce the risk below this level without delay.
High	High risks are undesirable. They can only be tolerated if it is not reasonably practicable to reduce the risk further. High risks are considered to be on the verge of being unacceptable and must be given immediate priority.
Medium	Medium risks are generally tolerable if it is not reasonably practicable to reduce the risk further. Additional treatment measures should be sought if significant benefit can be demonstrated and/or there is an additional treatment measure which is recognized as good practice in other like environments.
Low	Low risks are considered to be broadly acceptable. If options for further risk reduction exist and cost are proportionate to the benefit, then implementation of such measure should be considered.

The assessment process identified a total of 18 climate risks for the project, as detailed in Appendix Q (Climate change adaptation plan). By 2090, there were:

- Three low risks
- Ten medium risks
- Five high risks.

No extreme risks were identified.

All identified 'high' risks are required to be addressed by specific design responses and have actions and responsibilities assigned to them.

High risks were identified for the following climate risk areas:

- Bushfire
- Increase in average temperature
- Dry periods and regional drought
- Higher frequency of extreme heat.

The high risks and associated design responses to manage and mitigate them that are to be investigated during detailed design are described in Table 20-4. Furthermore, the design responses align with and expand upon the key actions that were included in the scoping report, which were:

- To design façade materials to withstand extreme temperatures and solar exposure
- To design guttering and drainage to accommodate future rainfall capacity
- To ensure electrical systems have the capacity to accommodate future cooling requirements.

The full risk register and adaptation strategies can be found in Appendix Q (Climate change adaptation plan).

Table 20-4: Identified high risks in 2090 and associated design responses

Climate risk areas	Risks	Design responses to be investigated during detailed design
Bushfire	Distant bushfire smoke may blow into the station and cause poor air quality, poor visibility, increased airborne dust and particulate matter, flying ash and debris, leading to poor health outcomes for staff and travelers.	**Aim** | to improve ventilation and health • Increase the heating, ventilation, and air condition (HVAC) monitoring schedule to ensure filters are replaced frequently to maintain fresh airflow in conditioned areas • Develop proper management plans and public help points for people requiring medical assistance • Install smoke sensors that shut down mechanical systems when smoke is sensed to prevent smoke entering conditioned areas or overheating the system.
Increase in average temperature	Higher average temperatures could result in higher energy consumption and increased maintenance requirements due to increased reliance on air conditioning within enclosed spaces, such as in buildings and retail spaces.	**Aim** | to reduce energy consumption • Investigate optimal passive design (for example, window selection and shading strategy) to promote passive cooling of the building and reduce reliance on HVAC • Implement a night purge (releasing heat from the building to cool the internal temperature) and therefore reduce the need to run the HVAC during the day • Size the HVAC equipment based on appropriate design temperature, in-line with increased temperatures incurred by climate change, so that systems operate efficiently in future higher temperatures.

Climate risk areas	Risks	Design responses to be investigated during detailed design
Dry periods and regional drought	Drought could result in a reduced water supply, thereby reducing the availability of water in rainwater tanks on site, and/or an imposition of water restrictions, causing an increased reliance on the Sydney Water supply.	**Aim** | to reduce water consumption • Future proof the design to include shared recycled water systems • Implement appropriate metering, monitoring and response • Engage a recycled water purchase agreement • Add information signage to encourage water saving practices • Install taps, toilets, showers and appliances with Minimum Water Efficiency Labelling and Standards ratings • Use existing rainwater tanks on site for rainwater storage • Use low water species for landscaping • Install a smart dripline irrigation system which will consist of an automatic smart controller with a rain sensor and irrigation soil moisture sensor to ensure water is used efficiently.
Higher frequency of extreme heat	Higher frequency of extreme heat can cause decreased thermal comfort indoors, particularly in unconditioned spaces such as the Grand Concourse.	**Aim** | to improve ventilation and improve thermal comfort • Incorporate passive design principles into the design • Investigate tempered ventilation solutions • Provide amenities such as drinking fountains, increased retail, food, and beverage locations • Design more spaces for rest • Increase areas of planting and shading to reduce the urban heat island effect.
Higher frequency of extreme heat	A higher frequency of extreme heat may cause degradation of vegetation and biodiversity within Eddy Avenue Plaza and the Western Forecourt.	**Aim** | plant more climate tolerant species that reduce the urban heat effect • Select low water use species for landscaping • Install a smart dripline irrigation system which will consist of an automatic smart controller with a rain sensor and irrigation soil moisture sensor to ensure water is used efficiently.

20.3 Environmental management measures

Both positive and negative climate change impacts will be addressed in the form of management measures. Measures to minimise impacts relating to greenhouse gas, resource efficiency, traffic and air quality are addressing in other chapters and have not been included here. Table 20-5 lists the measures to manage climate change impacts specifically.

Table 20-5: Environmental management measures – climate change

Ref	Impact / Uncertainty	Environmental management measures	Timing
CC01	Impact | Climate change risks	Climate change risk treatments identified in Table 20-4 will be confirmed and incorporated into the detailed design.	Detailed design
CC02	Impact | Greenhouse gas emissions	An iterative process of greenhouse gas assessments and design refinements will be carried out during detailed design and construction to identify opportunities to minimise greenhouse gas emissions. Performance will be measured in terms of a percentage reduction in greenhouse gas emissions from a baseline inventory calculated at the detailed design stage. The Carbon Estimate and Reporting Tool (Transport for NSW, 2017a) will be used to estimate the project's emissions.	Detailed design / construction
CC03	Impact | Sustainability	Sustainability initiatives (such as solar panels, LED lighting, water efficient fixtures) will be considered and incorporated where appropriate in the detailed design and construction of the project. A **Sustainability Management Plan** will be prepared to guide the sustainability outcomes of the project. The project will seek a Green Star Rating through the GBCA Greenstar program.	Detailed design / construction
CC04	Impact | Climate change risks	Ongoing monitoring and updating of the Climate Change Adaptation Plan (Appendix Q) will be carried out to capture changes in climate projection data, climate risks and adaptation strategies in accordance with Transport's Climate Risk Assessment Guidelines (2021) and the requirements of Green Star Buildings version 1.0 (Green Building Council of Australia, 2020).	Detailed design / construction / operation